Dear Zhangbu,

The internal review committee has finished our review of the iTPC upgrade proposal. We conducted the review by studying the proposal, discussing via emails, hearing the presentations during the one-day review meeting on Feb.5, and the ensuing discussions. We find the proposed iTPC upgrade will significantly increase STAR's capability for the BES-II program starting in FY18. The proposal team made a strong case in their presentations. The schedule of the proposed upgrade is aggressive and there are challenges in several places. Below are our specific answers to your charge questions to the committee. The committee strongly recommends the proponents revise the proposal taking into account the inputs from the review and submit the revised proposal to BNL/DOE on time.

The committee would like to thank the proposal team for their efforts in making a compelling case for the iTPC upgrade, answering our inquiries promptly, and putting together the informative presentations for the review meeting.

Best regards,

Fuqiang Wang on behalf of the committee:
Fuqiang Wang (Purdue, Chair)
Howard Wieman (LBL)
Geary Eppley (Rice)
Dick Majka (Yale)
Dan Padrazo (BNL)
Bill Christie (BNL)
Bedanga Mohanty (NISER)

<<<<<<<<<<<<<<<<<<charge to the iTPC review committee <<<<<<<<<

STAR collaboration has proposed to upgrade the inner sectors of the Time Projection Chamber. We plan to conduct an internal review to address the following questions before a formal submission of the proposal to BNL/DOE in February 15, 2015:

- is the upgrade compelling in expanding the capabilities for STAR for the BES-II program?

The committee finds that the physics case of the iTPC upgrade for BES-II program is compelling. The iTPC upgrade will significantly extend the STAR pseudorapidity coverage and improve the quality of tracking and particle identification. The statistics gain due to the larger pseudorapidity coverage in all physics observables, taken together, is an important factor the iTPC upgrade will bring to the BES-II program. Without iTPC, 50% to a factor of 2 longer runs would be needed to achieve the same statistics, which virtually illustrates the cost effectiveness of the iTPC upgrade. More importantly, the iTPC can bring a significant improvement in data quality that cannot be achieved by simple statistics increases. The iTPC upgrade can bring several BES physics topics to the next level. These include:

- the order of magnitude reduction in background contamination due to the better dE/dx resolution in dilepton measurements to probe chiral symmetry restoration and resonance in-medium properties,
- the wider pseudorapidity coverage for fluctuation measurements of high moments of conserved quantities, which are essential for the critical point search,
- the wider pseudorapidity coverage for the proton v1 measurement as a function of pseudorapidity to probe phase transition and the softest point in the equation of state,
- a factor of 2 improvement in reaction plane resolution in 1<|eta|<2 for elliptic and higher order harmonic flow measurements and the much needed pseudorapidity gap between reaction plane and flow measurements,
- the wider rapidity coverage for proton and net-proton rapidity distributions which are the most important properties in BES heavy-ion collisions, i.e. the baryon density and baryon chemical potential,
- long-range ridge correlation measurement with over 3-unit pseudorapidity gap between particle pairs afforded by the iTPC in AA and future pA collisions,
- the wider pseudorapidity coverage to reliably measure the pion rapidity distribution width to possibly probe the softest of the equation of state, and
- the low transverse momentum reach where particle spectral differences are potentially sensitive to possibly new physics.

These qualitative improvements in the physics reach of STAR that can be only afforded by the iTPC upgrade should be emphasized more prominently in the proposal.

- Are the plans for the electronics development sound, and resources available?

The electronics portion of the upgrade is in excellent shape. The largest risk is the availability of the SAMPA chip. A strong team is in place to execute this portion of the upgrade.

Inclusion of a block diagram into the electronics section would make the overall design of the system easier to grasp, and the committee suggests that such a figure should be generated and included in the proposal.

- Does the team have a sufficient understanding of the existing mechanical and electric constraints of the sectors?

Yes, particularly if the strong backs are not being redesigned, or will only have very minor modifications. The large archaeological effort to recover the technical knowledge, specifications, and construction documents from the original TPC project has achieved nearly 100% success.

Because of the tight schedule and also because a reduction in the strong back material does not significantly reduce the overall material budget which also includes electronics etc., the committee recommends keeping the original strong back design, with only minor modifications to accommodate connections for the increased number of electronics channels.

Regarding the grid leak issue, if there is insufficient time/manpower to fully simulate and prototype the two solutions presented (i.e. more "dead" wires, or the ALICE "wall") to reduce the grid leak distortion for the TPC, the committee feels that a reasonably safe path to take would be to consider adding one or more additional dead wires.

-Do the proponents have a clear path of developing sufficient QA procedure, clear division of tasks and support among the proponents (i.e. China-STAR Collaborative efforts)?

It was made apparent in the proposal and the presentations that there is need for a technical leader (in addition to the project leader) to coordinate the engineering activities of the project. This could be a project engineer or a physicist with equivalent project management experience. This might not be a full-time activity for the manager but would appear to be at least a half-time activity. This seems to be reflected in the budget estimate for the project engineer.

The technical leader can develop a testing and QA plan in cooperation with the participating institutions and in particular, with the Chinese project.The Chinese project will function as an independent, parallel project so close coordination between the two projects will be required. Since the sector assembly will take place in multiple institutions, a detailed traveler needs to be developed to follow the sector and the components contributed to it during its assembly, QA, and testing. A major activity of the technical leader will be to develop this traveler and insure that it is filled out properly as construction progresses.

It would help if the sector assembly steps are summarized in a single place in the proposal. There needs to be a much better description of what assembly equipment is being designed and delivered to China. The Chinese project should participate in this design process.

How the pad-to-iFEE connectors are installed should be described in the proposal.

- Are the risks with the re-installation evaluated properly?

A thorough job of identifying all possible risk factors appears to be complete. This information should be included in the proposal. The formal evaluation of the risk factors is not complete and does not need to be complete at this stage of the project. A large part of this full evaluation may not be possible until the insertion tool design is complete. A description of possible insertion tool designs should be included in the proposal.

- Can the project be completed in time for the run-18 startup?

As a $2-$5M project, the earliest the project could likely receive DOE project funds would be late in calendar 2016. The entire project would need to be completed in one year to be ready for the Run 18 BES-II program. The committee feels that such a time schedule is extremely challenging, if not impossible. The committee sees this funding plan, and its inherent time delay, as the biggest risk to the iTPC project being ready for the FY18 physics run. For this reason, the committee recommends that the proponents consider possible changes to project (funding sources, scope, etc.) that could lead to the DOE cost for the project dropping comfortably below the $2M level.

The production of 24 strong backs, at the current estimated rate of 1 strong back per month, is a limiting factor to the schedule. If the strong backs are not redesigned, as the committee recommends, then the option of commercial production might be worth of investigating.

The committee feels that it is very important to the success of the project to construct and test a prototype sector. Besides cosmic ray test, it is important to test the prototype with the insertion tool and in the STAR real running environment hopefully in Run 16.

- Is the cost estimate reasonable at this stage of the proposal?

The cost estimate appears reasonable, however, not enough details are given in the proposal and there is not a clear separation of DOE budget and other sources. A budget needs to be prepared at the WBS x.x level with sufficient descriptions in the name of the WBS activity or else in supplemental material to describe each activity. The contingency should be disclosed as both a percent and an amount. The total for each WBS item including contingency needs to be shown. The final budget should just cover DOE funded activity. An attempt should be made to apply a set of guidelines to estimate the contingency. This is probably not absolutely necessary until a full-blown external project review but would be nice to have in the meantime to support the quality of the budget estimates.

In addition to the DOE project budget, a dollar estimate of the Chinese contribution and a description of the Chinese contribution should be included. This description can be WBS-like if desired. However, the Chinese contributed activities are not part of the project WBS. On the other hand, milestones should be included in the WBS schedule covering delivery of equipment and partially completed sectors to China and also covering the expected receipt of completed sectors from China.

The expected contributions of STSG (STAR Technical Support Group) should be described, particularly the design and fabrication of the insertion tool.

-where can the proposal be improved for a compelling and credible case?

We have already mentioned above a number of points where the proposal can be improved. A few additional suggestions below:

- The qualitatively new reach of BES physics by the iTPC upgrade could be highlighted more prominently, e.g. by using bold texts.
- Improvement over the existing TPC for fixed target program could be made more specific, e.g. by pointing to physics already extracted from the existing data.
- The project schedule should be improved.
- Where the strong backs will be produced should be fixed.